

# Steelhead Returns to Warm Springs National Fish Hatchery, 1978-2003



<http://helmutoller.com/streamside>

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## Introduction

The Warm Springs River is a major tributary of the Deschutes River in north-central Oregon, and supports a population of wild summer steelhead (*Oncorhynchus mykiss*). Summer steelhead in the Deschutes River basin are part of the mid-Columbia River Evolutionary Significant Unit that was listed as a threatened species by NOAA-Fisheries in 1999. Warm Springs National Fish Hatchery, located on the Warm Springs River, was constructed in 1978 and was initially designed to produce spring Chinook salmon (*Oncorhynchus tshawytscha*), summer steelhead, and rainbow trout (*Oncorhynchus mykiss*). The hatchery program is cooperatively managed by the Confederated Tribes of the Warm Springs Reservation of Oregon and the U.S. Fish and Wildlife Service. In 1981, the summer steelhead program was discontinued due to facility constraints and disease problems. The hatchery currently produces spring Chinook salmon for sport and Tribal harvests. Current operation of the hatchery is intended to conserve wild fish populations upstream of the hatchery by only allowing wild fish and a small proportion of hatchery spring Chinook salmon to pass upstream of the hatchery (CTWSRO and USFWS 2002). A barrier dam blocks all upstream migration of fish and diverts fish into a fish ladder located at the hatchery. This report summarizes information collected by hatchery personnel on adult steelhead populations passing through the fish ladder at Warm Springs National Fish Hatchery.

## Study Area and Methods

The Warm Springs River drains approximately 1361 km<sup>2</sup> of land and enters the Deschutes River at Rkm 135. The river is contained entirely within the Warm Springs Indian Reservation. Including tributaries, an estimated 111 Rkm of stream habitat is available to anadromous fish above the barrier dam (Cates 1992). A fish barrier dam located adjacent to Warm Springs National Fish Hatchery at Rkm 16 of the Warm Spring River blocks all upstream migration of fish and directs them into a fish ladder located at the hatchery (Figure 1).

The hatchery and associated barrier dam became fully operational in 1978. Fish entering the ladder are either directed into holding ponds at the hatchery or may continue through the ladder and pass upstream of the barrier dam. During the spring Chinook migration period, generally from 15 April to 30 September, an automated fish passage system is used to passively separate returning hatchery spring Chinook salmon from wild fish. The passage system works by detecting coded-wire tags in returning hatchery spring Chinook salmon and diverting them into holding ponds while allowing untagged fish to pass upstream through the fish ladder and above the barrier dam. When the automated passage system is in use, a video monitoring system is used to identify and count fish passing upstream.

In an attempt to preserve the genetic integrity of wild steelhead in the Warm Springs River above the barrier dam, hatchery personnel remove all hatchery steelhead as they pass through the fish ladder. Since Warm Springs National Fish Hatchery does not propagate steelhead and hatchery steelhead are not released into the Warm Springs River, any hatchery steelhead that migrate up the Warm Springs River are straying from their route to their release location. In order to sort out hatchery steelhead, the automated

passage system is not used until the upstream migration of steelhead has ended, usually in late April. During the steelhead migration period, all upstream migrating fish were diverted from the fish ladder into holding ponds at the hatchery. Hatchery personnel then hand sorted the fish. Fish were sedated using CO<sub>2</sub>, and sorted according to presumed origin. All hatchery steelhead were identified as having missing fins or maxillary bones as a result of marking prior to release, or eroded dorsal fins resulting from rearing in hatchery ponds. The hatchery steelhead were sorted out, killed, and distributed for food to the Confederated Tribes of the Warm Springs Reservation of Oregon. These fish were classified as stray hatchery steelhead in this report. All unmarked steelhead were passed upstream of the barrier dam and were classified as wild steelhead for the purposes this summary. It is possible that some steelhead classified as wild were in fact of hatchery origin, for example if the hatchery fish were not externally marked prior to release and did not have obvious eroded dorsal fins.

Hatchery personnel recorded the total number of wild (unmarked) steelhead passed upstream and total number of stray hatchery (marked) steelhead for each day. Prior to 1991, daily totals and other information was recorded on data sheets and summarized in hard copy reports. Much of the information prior to 1991 was summarized in a progress report by Cates 1992. Since 1991, the daily totals and return information have been entered into a database and stored in the Columbia River Information System managed by the Columbia River Fisheries Program Office (CRiS Database).

Snouts from hatchery steelhead with an adipose and left-ventral fin-clip, identifying the presence of a coded-wire tag, were collected by the hatchery and sent to the Columbia River Fisheries Program Office for recovery. Coded-wire tags were read and the Regional Mark Information System's database was queried to determine release information for the coded-wire tag group. Most hatcheries in the Columbia River basin do not release steelhead smolts that are 100% coded-wire tagged, instead a proportion of fish are tagged from each release group. In order to estimate the total number of stray hatchery steelhead trapped at Warm Springs National Fish Hatchery that originated from an individual hatchery, an expanded recovery number was estimated by using the ratio of the number of coded-wire tagged fish from each group (CWT group) released from a particular hatchery to the total number of fish released in that group (CWT group) from the hatchery according to the formula:

$$\text{Exp}_A = \sum_{x=1}^n \frac{(\text{Rec}_X) * (\text{Tot}_X)}{(\text{Tag}_X)}$$

Exp<sub>A</sub> = Expanded recoveries, or estimated total numbers, of stray hatchery steelhead of all CWT groups from Hatchery A recovered at WSNFH  
 Rec<sub>X</sub> = Number of coded-wire tags from CWT group X recovered at WSNFH  
 Tot<sub>X</sub> = Total number of fish released from Hatchery A associated with CWT group X  
 Tag<sub>X</sub> = Number of fish coded-wire tagged from CWT group X released from Hatchery A

Other information on steelhead trapped at Warm Springs National Fish Hatchery was intermittently collected. Sex, determined by external visual characteristics, and length information were recorded for wild steelhead passed above the barrier dam from 1979 to 1990. Since 1990, sex and length information was intermittently collected from a small number of wild and hatchery fish.

**[Click Here For Map](#)**

Figure 1. Map of Deschutes River subbasin and location of barrier dam located at Warm Springs National Fish Hatchery (Rkm 16).

## **Results**

The number of wild and stray hatchery steelhead counted at the fish ladder at Warm Springs National Fish Hatchery are shown in Table 1 and Figure 2. The median number of wild steelhead returning to the fish ladder on the Warm Springs River between 1982 and 2003 was 332 with a range of 81 to 880. The median number of stray hatchery steelhead counted during the same period was 157 with a range of 35 to 988. The estimated number of wild and stray hatchery steelhead passing Sherars Falls is shown in

Figure 3. The number of stray hatchery steelhead counted at the fish ladder at Warm Springs National Fish Hatchery increased substantially beginning in 1987 (Table 1). Stray hatchery steelhead composed a mean of 13.6% (range of 6.6% to 23.0%) of the total number of steelhead counted at the ladder from 1982 to 1986. Since 1987, a mean of 50.9% (range of 34.7% to 66.4%) of the steelhead counted were stray hatchery fish (Figure 4).

Table 1. Number of wild and stray hatchery steelhead counted at the fish ladder at Warm Springs National Fish Hatchery, 1982-2003 (Cates 1992 and CRiS Database 2003).

Year	Wild				Stray Hatchery			
	Males	Females	Unknown	Total	Males	Females	Unknown	Total
1982	196	373	-	569	-	-	40	40
1983	56	199	-	255	-	-	35	35
1984	174	257	-	431	-	-	129	129
1985	200	377	-	577	-	-	89	89
1986	133	240	-	373	-	-	56	56
1987	234	588	-	822	-	-	692	692
1988	131	391	-	522	-	-	699	699
1989	123	262	-	385	-	-	205	205
1990	130	209	-	339	-	-	182	182
1991	-	-	165	165	-	-	129	129
1992	-	-	280	280	9	5	383	397
1993	24	44	13	81	5	3	107	115
1994	33	41	61	135	-	-	147	147
1995	47	37	11	95	4	6	96	106
1996	28	50	7	85	32	24	112	168
1997	92	119	32	243	-	-	349	349
1998	-	-	214	214	-	-	380	380
1999	18	28	52	98	11	13	58	82
2000	-	-	325	325	16	4	401	421
2001	-	-	509	509	20	39	260	319
2002	-	-	734	734	7	17	964	988
2003	-	-	880	880	-	-	578	578

### Steelhead Returns to Warm Springs National Fish Hatchery 1982-2003

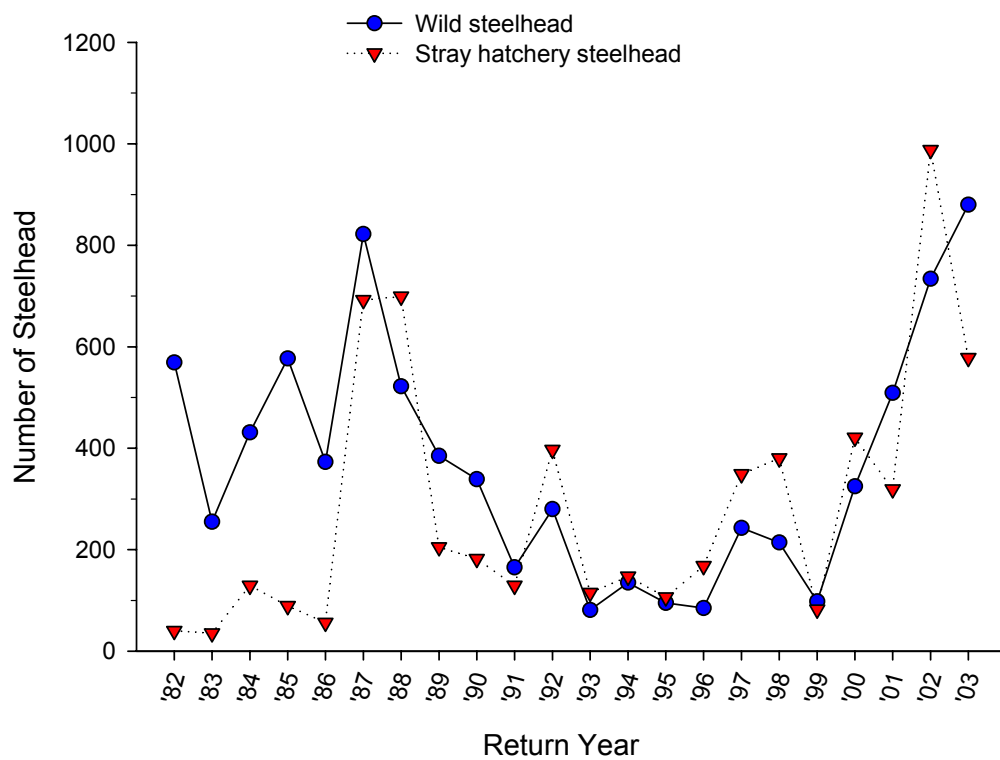


Figure 2. Steelhead returns counted at the barrier dam at Warm Springs National Fish Hatchery, Rkm 16 of the Warm Springs River. Steelhead enter the Warm Springs River from the Deschutes River in the year of spawning.

# Estimated Summer Steelhead Escapement Past Sherars Falls 1979-2002

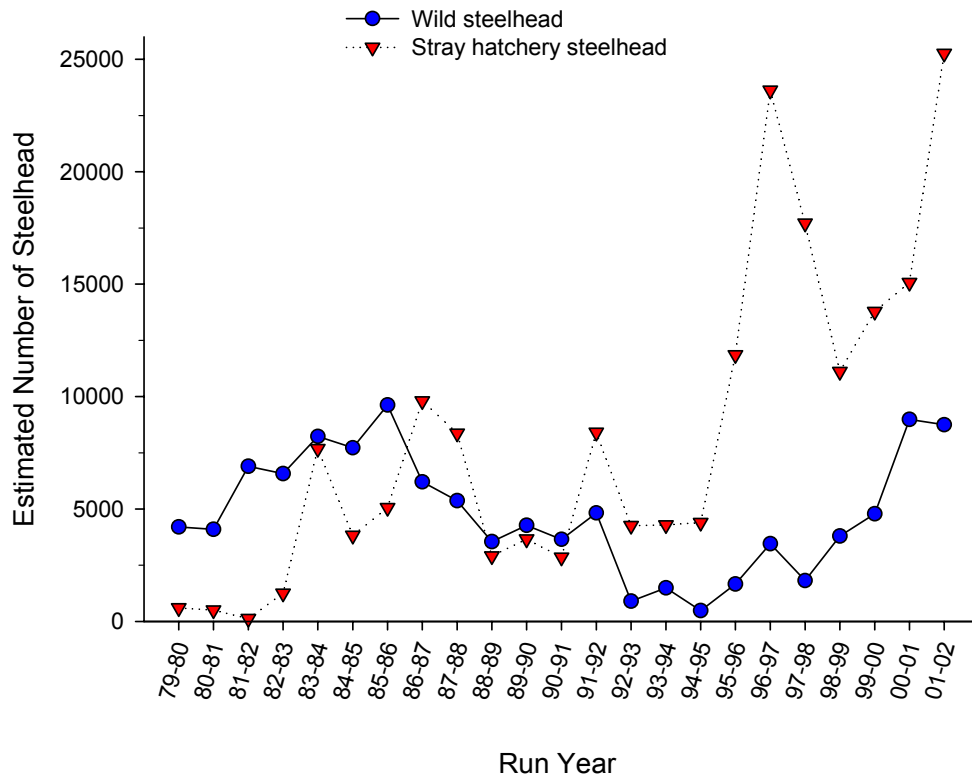


Figure 3. Estimated number of summer steelhead passing Sherars Falls (Rkm 71) by origin. Steelhead spawning in the spring begin passing Sherars Falls in the summer of the previous year, i.e. run year '79-'80 begins passing the falls in the summer of '79 and spawn in the spring of '80. Estimates are based on a Peterson mark-recapture method developed by ODFW (Steve Pribyl, ODFW, personal communication).

Percent Stray Hatchery Steelhead Returning  
to Warm Springs National Fish Hatchery  
1982-2003

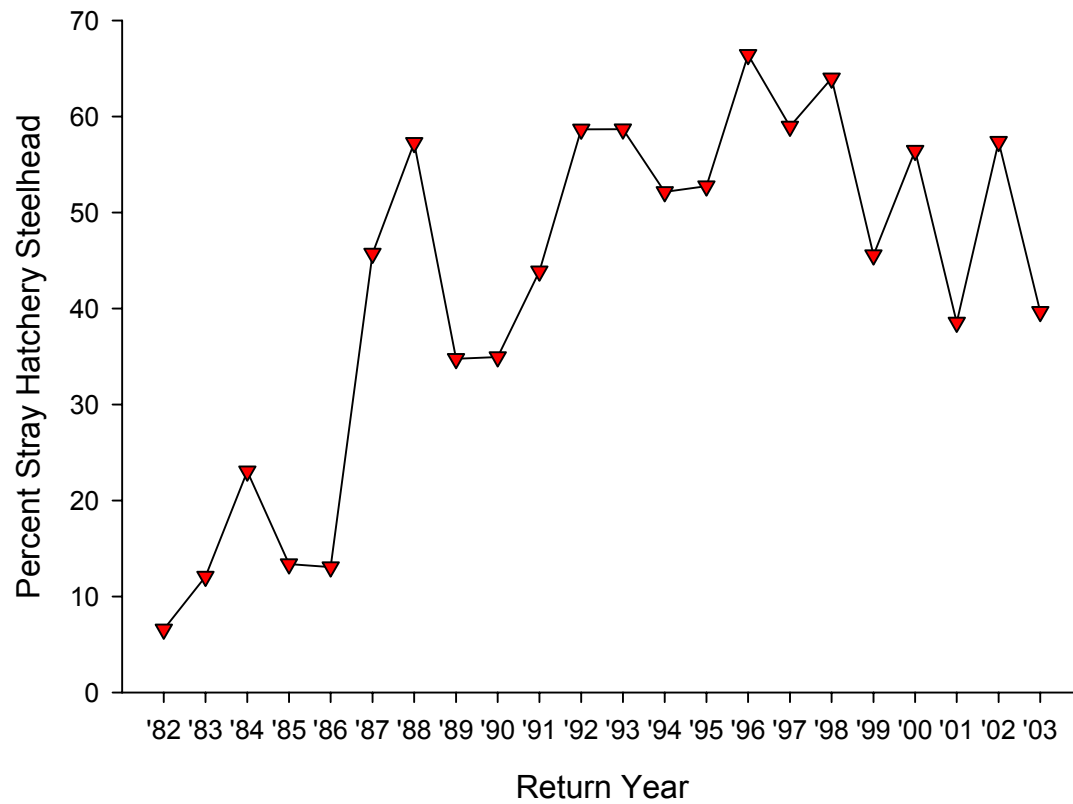


Figure 4. The percentage of stray hatchery steelhead in the total steelhead return to the barrier dam at Warm Springs National Fish Hatchery.



Expanded recovery numbers for coded-wire tag recoveries of hatchery steelhead accounted for 37%, or 1,809 of the 4,910 total hatchery steelhead recovered from the fish ladder between 1987 and 2002 (Figure 5). Fish reared at Irrigon Hatchery and released in the Wallowa, Imnaha, and Grande Ronde rivers made up 87% of the fish that could be accounted for through coded-wire tag expansion. The other 13% of the total were reared at hatcheries located along the Snake River basin, including Cottonwood Creek Hatchery, Niagra Springs Hatchery, Magic Valley Hatchery, and Dworshak National Fish Hatchery.

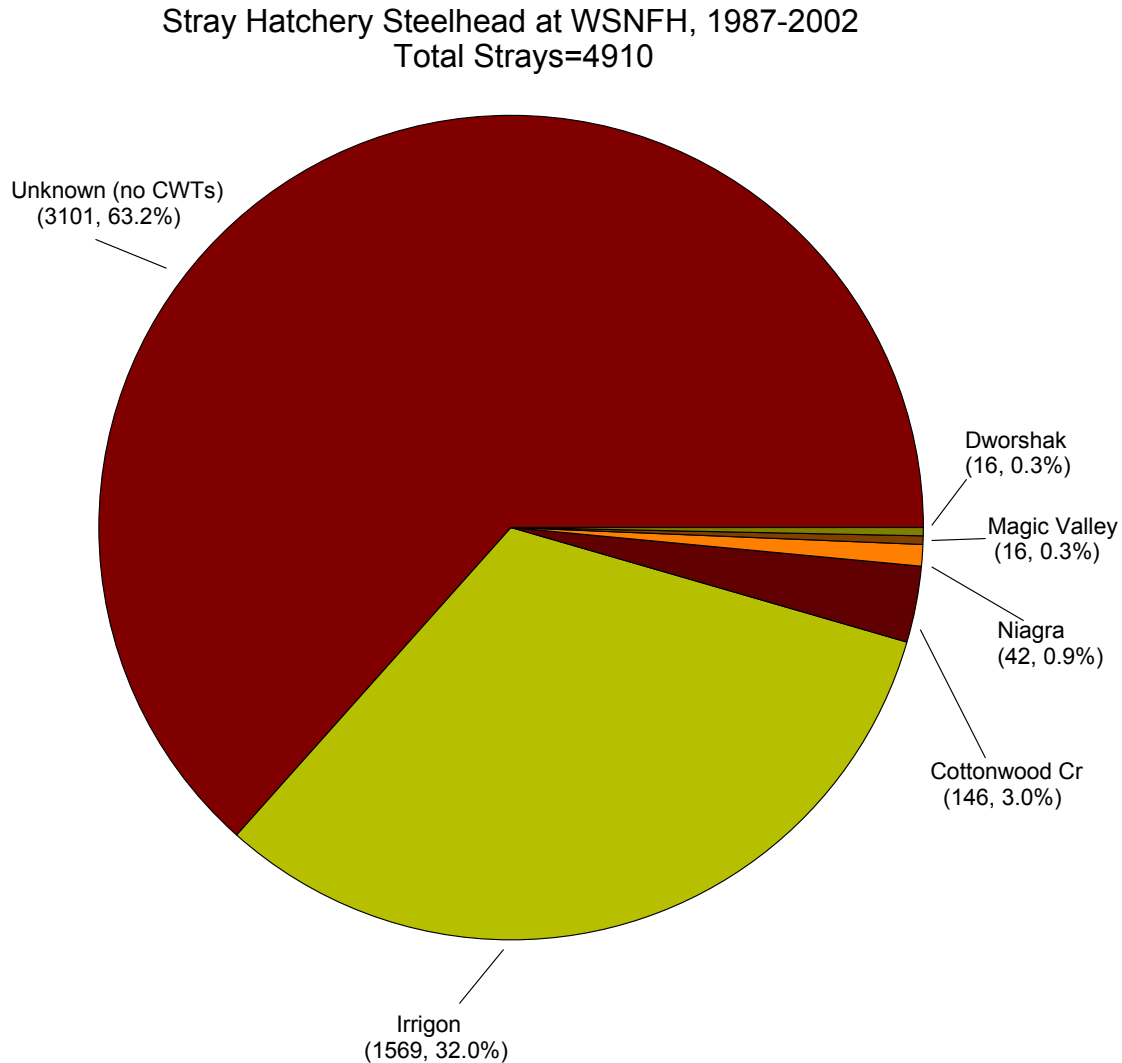


Figure 5. Origin of stray hatchery steelhead recovered from the fish ladder at Warm Springs National Fish Hatchery, 1987-2002. Numbers of known origin are based on expanded coded-wire tag (CWT) recoveries. Unknowns are fish which did not have CWT's and could not be assigned an origin. Hatcheries are where fish were raised, not necessarily where they were released.

Time of entry into the fish ladder was different for wild and stray hatchery steelhead. Cumulative run timing for wild and stray hatchery steelhead from 1993 to 2002 is shown in Figure 6. The median day of entry to the fish ladder, i.e. the day when half of the total run has passed through the ladder, for stray hatchery steelhead was 14 days earlier than for wild steelhead (95% CI=7-22 days) between 1993 and 2002, with an average median day of return of 31 March for stray hatchery steelhead and 13 April for wild steelhead (Figure 7). No significant change in run timing was detected for either wild or hatchery steelhead since 1982.

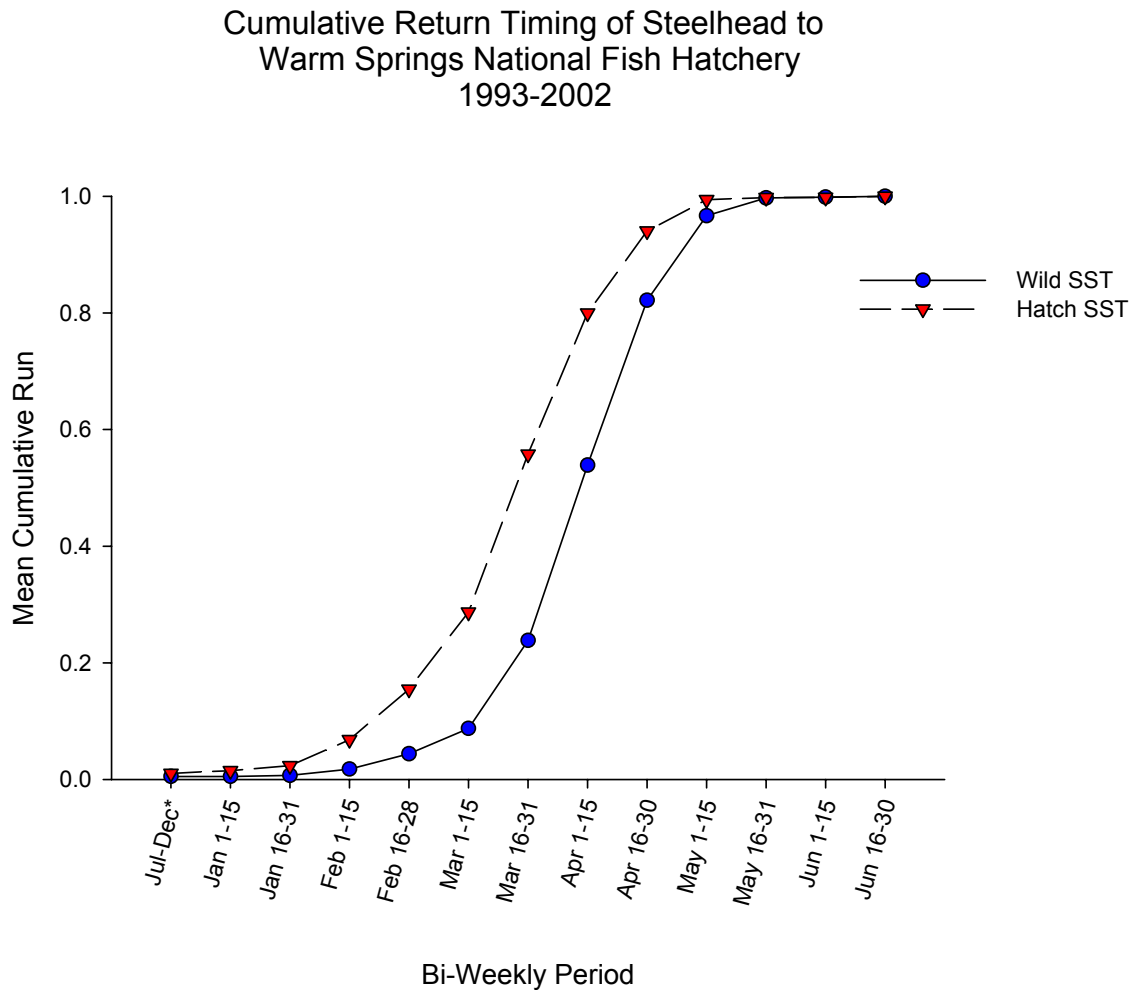


Figure 6. Mean cumulative run timing for wild and hatchery summer steelhead returning to WSNFH. \*Run year for steelhead in the Warm Springs River is based on a 1 July to 30 June return time to the hatchery.

# Median Day of Return to Warm Springs National Fish Hatchery 1993-2002

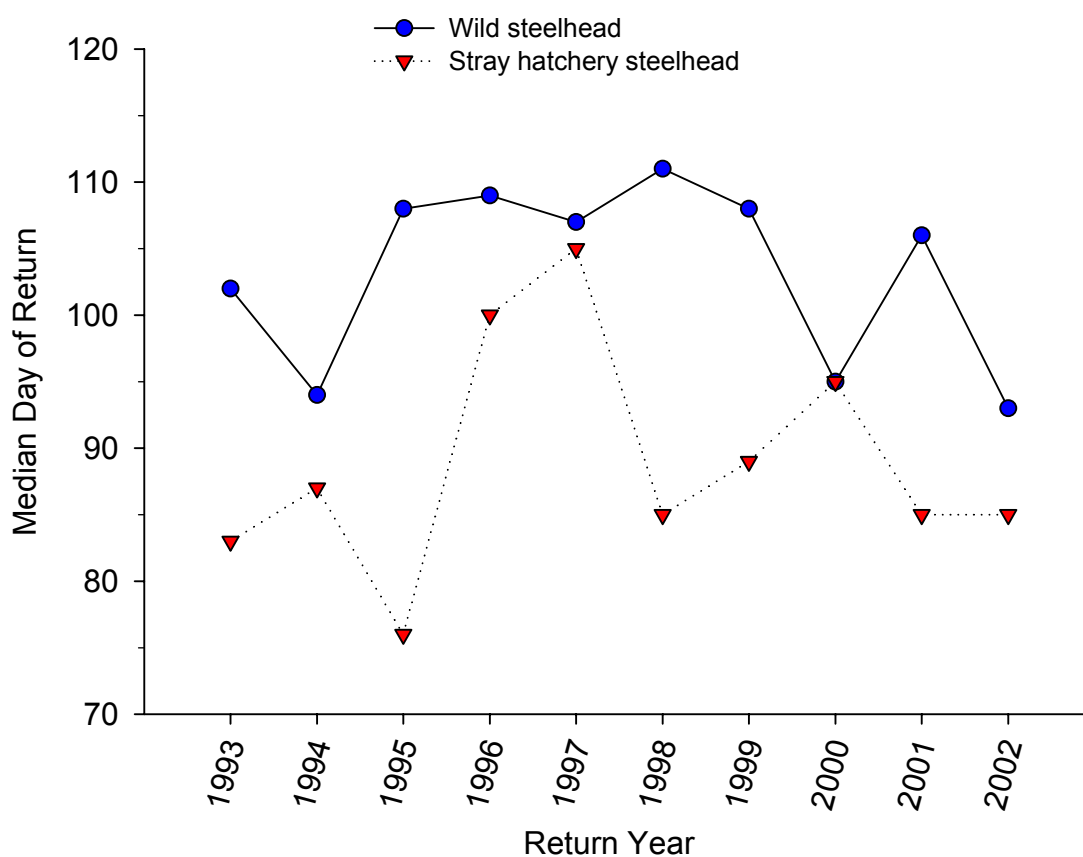


Figure 7. Median day of return for steelhead to Warm Springs National Fish Hatchery. Median day is listed as the day of the year when half of the total run had entered the hatchery (e.g. day 100 is 10 April for non-leap years).

Mean lengths of wild and hatchery steelhead for 1978 to 2002 are summarized in Table 2. The length frequencies for wild steelhead between 1984 and 1989 are shown in Figure 8.

Table 2. Mean length of wild and stray hatchery steelhead sampled at Warm Springs National Fish Hatchery, 1978-2002 (Cates 1992 and CRiS Database 2003).

Wild					Hatchery			
Year	N	Mean Length (cm)	SD	Range	N	Mean Length (cm)	S.D.	Range
1978	90	64.3	7.52	29-77	-	-	-	-
1979	52	66.4	6.14	54-77	-	-	-	-
1980	125	63	8.73	54-84	-	-	-	-
1981	18	62.2	5.49	56-72	-	-	-	-
1982	68	64.9	6.26	54-78	-	-	-	-
1983	15	67.1	4.81	59-73	25	69.8	5.91	55-86
1984	53	61.5	5.84	48-81	-	-	-	-
1985	131	65.7	8.94	52-81	26	69.8	9.95	54-92
1986	29	63	6.15	53-81	-	-	-	-
1987	150	68.7	3.5	54-84	-	-	-	-
1988	38	68	5.13	57-86	18	64.7	6.07	58-79
1989	42	66.7	5.37	56-77	46	60.7	5.39	51-76
1990	51	65.3	6.19	53-77	31	66.9	5.99	59-80
1991	-	-	-	-	25	63.1	6.49	53-75
1992	-	-	-	-	50	63.6	6.37	52-78
1993	-	-	-	-	24	63.0	5.91	54-76
1994	-	-	-	-	31	69.0	5.15	60-79
1995	-	-	-	-	18	64.9	7.36	54-79
1996	-	-	-	-	62	63.5	5.15	57-75
1997	-	-	-	-	35	65.6	7.03	55-80
1998	-	-	-	-	197	65.6	7.85	53-99
1999	-	-	-	-	37	65.9	6.96	54-85
2000	-	-	-	-	52	60.1	3.92	54-79
2001	-	-	-	-	-	-	-	-
2002	-	-	-	-	242	62.7	6.09	36-82

### Length of Wild Steelhead Returns to Warm Springs National Fish Hatchery, 1984-1989

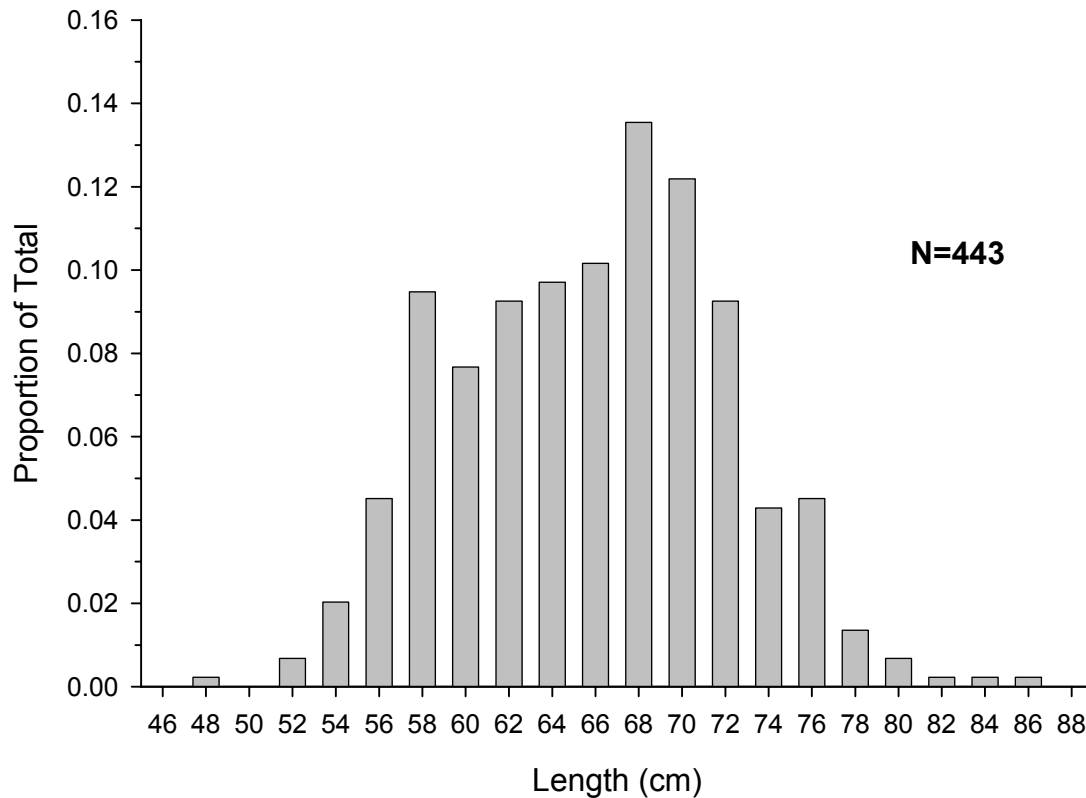


Figure 8. Length frequency of wild (unmarked) steelhead measured at Warm Springs National Fish Hatchery, 1984-1989.

### Discussion

Wild steelhead numbers in the Warm Springs River have rebounded from very low numbers in the 1990's to 880 fish in 2003, the highest number recorded since the barrier dam was constructed. This trend is similar to the trend seen for the Deschutes River basin as a whole. A corresponding increase in the number of stray steelhead during this time indicates that improvements in conditions in the ocean or the freshwater migration corridors may be responsible for increased smolt to adult survival rates.

Although hatchery personnel do not allow hatchery steelhead to pass above the barrier dam, this is based on visual identification of hatchery fish. Not all steelhead released from hatcheries in the Columbia River basin are 100% fin-clipped. For example, in 2000 91.6% of steelhead released from state, Federal, and Tribal fish hatcheries were adipose clipped (Steve Pastor, USFWS, personal communication). Unmarked hatchery fish that enter the fish ladder may not be culled out if they do not have obvious signs of fin erosion, although hatchery personnel have identified some stray

hatchery fish based on eroded dorsal fins only. A return to 100% fin-marking of steelhead released from hatcheries in the Columbia Basin will reduce the likelihood of hatchery fish being passed upstream into the Warm Springs River. Determining the origin of stray hatchery steelhead in the Warm Springs River is also complicated by the lack of a comprehensive coded-wire tagging program for hatchery steelhead releases. Over 63% of the stray hatchery steelhead collected at Warm Springs National Fish Hatchery could not be assigned a release location due to the absence of coded-wire tags. While Irrigon Hatchery is the source of most of the stray steelhead that can be accounted for by coded-wire tags, hatcheries that do not coded-wire tag and adipose left-ventral fin-clip representative release groups may also be contributing a significant number of strays to the Warm Springs River. Round Butte Hatchery, located 31 Rkm upstream of the mouth of the Warm Springs River on the Deschutes River, is the only hatchery in the Deschutes River basin that releases hatchery steelhead. Round Butte annually releases around 160,000 steelhead smolts into the Deschutes River. All releases from Round Butte are marked with an adipose and either a right or left maxillary clip. Very few (<6) of these marked adults have been recovered at Warm Springs National Fish Hatchery since 1982, indicating that Round Butte Hatchery does not appear to be the source of the strays.

Despite the limitations that the lack of a comprehensive coded-wire tagging program places on any analysis of the strays, it appears that hatchery steelhead released from facilities in the Snake River basin are the source of a significant number of the hatchery steelhead sampled in the Warm Springs River. Several hatcheries in the Snake River basin were constructed in the early 1980's as part of the Lower Snake River Compensation Plan. The large increase in the percentage of stray hatchery steelhead in the Warm Springs River that began in 1987 coincides with the first adult returns of hatchery fish released from several of these facilities. Irrigon Hatchery, in particular, has been a major source of strays, accounting for 87% of the fish of known origin since 1987. Irrigon Hatchery began releasing summer steelhead in the Wallowa, Imnaha, and Grande Ronde rivers in 1985.

A significant number of the stray hatchery steelhead that enter the Deschutes basin and pass Sherars Falls (Rkm 71) are thought to leave the basin before spawning. Based on floy-tagging and radio-telemetry, an estimated 50% of the stray hatchery steelhead passing Sherars Falls left the Deschutes basin prior to spawning (Chilcote 2003; Steve Pribyl, ODFW, personal communication). It is unlikely, however, that stray hatchery steelhead from the Snake River hatcheries that were trapped and killed at Warm Springs National Fish Hatchery would have left the Deschutes basin prior to spawning if they were allowed to continue migrating up the Warm Springs River. Steelhead spawning generally occurs from early March through June. Steelhead that enter the fish ladder at Warm Springs National Fish Hatchery in the spring entered the Deschutes River during the previous summer and fall and are generally in spawning condition when they arrive at the fish ladder (Cates 1992). Since Warm Springs National Fish Hatchery is located 151 Rkm upstream from the confluence of the Deschutes and Columbia rivers, the combination of river distance, spawning condition, and run-timing makes it likely that these fish would attempt to spawn in Warm Springs River if given the chance. The stray fish, after having spent the winter in the Deschutes River, would have to swim back downstream to the Columbia River and, in the case of the Grande Ronde River, swim

another 463 Rkm to return to their stream of release before spawning. The policy of removing the stray hatchery fish from the Warm Springs River has created a wild steelhead sanctuary above the barrier dam at Warm Springs National Fish Hatchery. Given the magnitude of the number of strays in the Deschutes River basin, the area above the barrier dam is likely the only spawning location in the basin that has had limited mixing of hatchery and wild steelhead stocks.

Limited information is currently being collected on wild steelhead returning to the Warm Springs River. Given the increased interest in steelhead populations in the Deschutes River, a sampling plan should be developed to collect additional information of wild steelhead in the Warm Springs River. Length, sex, and age information based on scale analysis, could be collected from a subsample of the returning adults at the hatchery before they are passed upstream. The Confederated Tribes of the Warm Springs Reservation of Oregon collect information on juvenile fish production in the Warm Springs River and also conduct annual spawning ground surveys for steelhead on Reservation waters. Information gathered from these surveys can be obtained by contacting the Tribe's Department of Natural Resources.

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